

Draft

**Phase 2 Focused
Feasibility Study
Technical Memorandum
LNAPL Source Area
Technology Screening**

**for the
Diamond Head Oil Superfund
Site
Kearny, New Jersey**

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1.0 Introduction

This draft Technical Memorandum (TM) is submitted to the U.S. Environmental Protection Agency (USEPA), Region 2, as part of Task Order DH02 under Contract Number DACA87-02-D-0006 with the Army Corps of Engineers, Huntsville District.

The purpose of this TM is to present the results of the screening evaluation for likely remedial technologies that can be used as part of an interim remedial measure (IRM) for the light non-aqueous phase liquid (LNAPL) currently found at the Diamond Head Oil Superfund Site ("Site") located in Kearny, Hudson County, New Jersey. This screening evaluation includes identification of applicable or relevant and appropriate requirements, response action objectives, and preliminary remedial goals as well as initial screening of technologies based on implementability, cost, and effectiveness criteria.

This technical memorandum is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Background and History
- Section 3 – Nature and Extent of LNAPL within the Source Area
- Section 4 – Summary of Applicable or Relevant and Appropriate Requirements
- Section 5 – Response Action Objectives
- Section 6 – Preliminary Remedial Goals (PRGs)
- Section 7 – Identification and Screening of Technologies for LNAPL Treatment
- Section 8 – Conclusions
- Section 9 – References

2.0 Site Background and History

The Site is currently inactive and consists of approximately 15 acres of undeveloped land located near the Hackensack Meadowlands. The property is currently owned by the Hudson Meadows Urban Development Corporation. The area surrounding the Site is industrial; there are no residential areas in the vicinity of the Site. Land use within 1000 feet of the Site consists of light industrial to the north, northwest and west and wetlands (meadowlands) to the east, northeast, and south.

The Site is a former oil-reprocessing facility that operated from February 1, 1946, to early 1979. During facility operations, multiple aboveground storage tanks (ASTs) and possibly below grade pits were used to store oily wastes. These wastes were intermittently discharged directly to adjacent properties to the east and the wetland area on the south side of the Site, creating an oil lake. From the close of operations in 1979 until 1982, the abandoned site was not completely fenced. It was reported that during this time, oily wastes and other debris were dumped at the Site (CH2M HILL 2005).

In 1968, the New Jersey Department of Transportation (NJDOT) acquired the property to the south of the Site, and in 1977, when beginning construction of I-280, reportedly removed 9 million gallons of oil-contaminated water and 5–6 million cubic yards of oily sludge from

the oil lagoon. The NJDOT also reported that during the I-280 construction, an underground "lake" of oil-contaminated groundwater was found extending from the eastern limits of the I-280 right-of-way to Frank's Creek to the west of the Site. During the process of constructing I-280, the entire oil lagoon was apparently filled, as it no longer appears on post-I-280 construction aerial photographs. There is no further information on the oil and sludge removal from the lagoon and whether the excavation was completed to the native soils prior to filling or a sludge layer was left at the bottom of the lagoon.

In 1982, approximately 7,500 gallons of materials were apparently pumped out of the tanks and disposed off site. During the same time, 27 tons of contaminated soil were reportedly removed from the Site (location at the Site from where they came is unknown). Aerial photographs from 1982, show that the reprocessing infrastructure of the Site had been dismantled.

3.0 Nature and Extent of LNAPL within the Source Area

A Phase I Remedial Investigation (CH2M HILL 2005) was conducted and outlined three areas as potential sources that may be continuing to release contamination to the environment:

- Landfill—with an approximate area of 7 acres
- Oil-reprocessing section of the Site—with two buildings, multiple ASTs, drum storage areas, and possibly underground pits
- Oil lagoon—with an approximate area of 5 acres located over the south section of the Site and extending outside the Site's boundaries to the east and south

Currently, in the oil-processing section of the Site, only the foundations of one of the buildings and two of the ASTs are visible. While the general location of the landfill can be identified, its exact limits are often unclear because the elevation changes gradually and debris is present over the entire Site and cannot serve as a demarcating factor. There are no physical demarcations at the Site that can be used to establish the boundary of the former lagoon. Historic information suggests that the lagoon occupied the southeast section of the Site and extended eastward from there beyond the current boundary of the Site.

LNAPL is present in the southeast corner of the Site in the area of the former lagoon. The LNAPL covers an area of approximately 80,000 ft², accumulates up to approximately 5 ft thickness in some monitoring well locations, and is estimated to affect between 2,800 and 5,000 cubic yards of the vadose zone (CH2M HILL 2005).

The LNAPL was characterized as having more of a diesel range fraction than a gasoline range fraction and was found to contain benzene, toluene, ethylbenzene and xylenes as well as a number of SVOCs and metals, including lead. The LNAPL would be classified as a hazardous waste based on its ignitability but did not exceed TCLP limits (CH2M HILL 2005).

A Phase 2 Focused Remedial Investigation is planned to further delineate the source area of LNAPL at the Site and to confirm whether or not the landfill is a potential source. The Phase 2 Remedial Investigation activities are planned for 2007.

4.0 Summary of Applicable or Relevant and Appropriate Requirements

Remedial actions must be protective of public health and the environment. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that attain or exceed Applicable or Relevant and Appropriate Requirements (ARARs). The purpose of this requirement is to make CERCLA response actions consistent with other pertinent federal and state environmental requirements, as well as to adequately protect public health and the environment.

Definitions of the ARARs and the "to be considered" (TBC) criteria are given below:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that directly and fully address a hazardous substance, pollutant, contaminant, environmental action, location, or other circumstance at a CERCLA site.
- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law, which while not "applicable," address problems or situations sufficiently similar (relevant) to those encountered at a CERCLA site, that their use is well suited (appropriate) to the particular site.
- TBC criteria are non-promulgated, non-enforceable guidelines or criteria that may be useful for developing an interim remedial action, or are necessary for evaluating what is protective to human health and/or the environment. Examples of TBC criteria include the NJDEP Soil Cleanup Criteria (combined Tables 3-2 and 7-1 from the NJDEP's February 3, 1992 proposed rule titled Cleanup Standards for Contaminated Sites N.J.A.C. 7:26D), which includes the Residential Direct Contact Soil Cleanup Criteria (RDCSCC), the Non-Residential Direct Contact Soil Cleanup Criteria (NRDCSCC), and Impact to Groundwater Soil Cleanup Criteria (IGWSCC), as well as the USEPA Drinking Water Health Advisories, Reference Doses, and Cancer Slope Factors.

Another factor in determining which requirements must be addressed is whether the requirement is substantive or administrative. "Onsite" CERCLA response actions must comply with the substantive requirements but not with the administrative requirements of environmental laws and regulations as specified in the National Contingency Plan (NCP), 40 CFR 300.5, definitions of ARARs and as discussed in 55 FR 8756. Substantive requirements are those pertaining directly to actions or conditions in the environment. Administrative requirements are mechanisms that facilitate the implementation of the substantive requirements of an environmental law or regulation. In general, administrative requirements prescribe methods and procedures (e.g., fees, permitting, inspection, reporting requirements) by which substantive requirements are made effective for the purposes of a particular environmental or public health program.

ARARs are grouped into three types: chemical-specific, location-specific, and action-specific. Included in Tables 1A through 1C are the chemical-specific, action-specific, and location-specific ARARs for the Site.

4.1 Chemical Specific ARARs

Chemical-specific ARARs include laws and requirements that establish health- or risk-based numerical values or methodologies for environmental contaminant concentrations or discharge. The chemical-specific ARARs for the LNAPL source area at the Site can be classified into two categories: (1) residual presence of LNAPL; and (2) land disposal restriction (LDR) concentrations that must be achieved if contaminated media that is either a characteristic hazardous waste or contains a listed hazardous waste, is excavated or extracted and later land disposed. Also, effluent concentrations that must be achieved in treatment of groundwater for discharge are also considered chemical-specific ARARs.

The ARAR for the LNAPL at the Site are the following New Jersey requirements for free-phase and residual LNAPL in NJAC 7:26E-1.13(b)2(v) and NJAC 7:26E-6.1(d):

- Removal or treatment of recoverable LNAPL where practicable
- Treatment of residual LNAPL where practicable
- Containment of LNAPL where removal or treatment are not practicable

It should be noted that the objective of this focused investigation is the source LNAPL (mobile and residual) rather than the sorbed chemical contamination in the soil at the Site. Additional investigations and feasibility evaluations are planned in the future to address the sorbed chemical contamination at the Site. For this sorbed contamination, the New Jersey Soil Cleanup Criteria would constitute TBCs (combined Tables 3-2 and 7-1 from the NJDEP's February 3, 1992 proposed rule titled Cleanup Standards for Contaminated Sites N.J.A.C. 7:26D; these include the RDCSCC, the NRDCSCC, and the IGWSCC).

The Resource Conservation and Recovery Act (RCRA) land disposal restrictions (LDRs) would apply to remedial actions performed at the Site if waste generated by the remedial action (e.g., contaminated soil) contains a RCRA hazardous waste. Listed hazardous wastes as defined by RCRA regulation are not known to have been released at the Site. As a result, excavated soils would not be required to be managed as listed hazardous wastes. If excavated and removed from the area of contamination (i.e., the soil is "generated"), the soil may be a characteristic hazardous waste.

Generated soils that exceed the Toxicity Characteristic Leaching Procedure (TCLP) limit must be managed as a hazardous waste and must meet the LDR Treatment Standards for contaminated soil (40CFR 268.49). The treatment standard for contaminated soil is the higher value of a 90 percent reduction in constituent concentrations or 10 times the Universal Treatment Standards (UTS). Treatment is required for the constituent for which the soil is a characteristic hazardous waste as well as other "underlying hazardous constituents". Generators of contaminated soil can apply reasonable knowledge of the likely contaminants present to select constituents for monitoring (USEPA, October 1998. *Management of Remediation Waste Under RCRA*, EPA530-F-98-026).

4.2 Action Specific ARARs

Action-specific ARARs regulate the specific type of action or technology under consideration, or the management of regulated materials. The most important action-

specific ARARs that may affect the remedial action objective (RAOs) and the development of remedial action alternatives is RCRA. RCRA regulations governing the identification, management, treatment, storage, and disposal of solid and hazardous waste would be ARARs for alternatives that generate waste that would be moved to a location outside the area of contamination. Such alternatives could include excavation of impacted soils. Requirements include waste accumulation, record keeping, container storage, disposal, manifesting, transportation and disposal. If generated soil is a characteristic hazardous waste, RCRA LDRs would apply and treatment would be required in accordance with RCRA prior to disposal. This includes treatment of other underlying hazardous constituents as required by 40 CFR 268.9(a).

4.3 Location Specific ARARs

Location-specific ARARs are requirements that relate to the geographical position of the Site. State and federal laws and regulations that apply to the protection of wetlands, construction in floodplains, and protection of endangered species in streams or rivers are examples of location-specific ARARs.

Table 1A
Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
Federal				
Resource Conservation and Recovery Act	Identification and Listing of Hazardous Waste	40 CFR 261	Defines those solid wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and 270.	ARAR for wastes or treatment residues which are hazardous as defined by RCRA and are to be disposed of off-site.
Federal Safe Drinking Water Act	National Primary Drinking Water Standards - Maximum Contaminant Level Goals (MCLGs) and Maximum Contaminant Levels (MCLs)	40 CFR 141	Establishes health-based standards for public drinking water systems. Also establishes drinking water quality goals set at levels at which no adverse health effects are anticipated, with an adequate margin of safety. The NCP specifically states that MCLs will be used as ARARs for useable aquifers rather than the more stringent MCLGs.	ARARs for groundwater concentrations following remediation but there are no MCLs for LNAPL.
Federal Safe Drinking Water Act	National Secondary Drinking Water Standards-Secondary MCLs	40 CFR 143	Establishes standards for public drinking water systems for those contaminants which impact the aesthetic qualities of drinking water (secondary MCL).	ARARs for groundwater concentrations following remediation but there are no MCLs for LNAPL.
Quality Criteria for Water	Water Quality Criteria	40 CFR 131 Quality Criteria for Water, 1976, 1980, and 1986	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	ARARs. If treated water needs to be discharged to surface water, these will be used in setting effluent discharge limits.
Federal Clean Water Act; National Pollution Discharge Elimination System (NPDES)	Toxic Pollutant Effluent Standards	40 CFR 129	Establishes effluent standards or prohibitions for certain toxic pollutants; i.e., aldrin/dieldrin, DDT, DDD, DDE, endrin, toxaphene, benzidine, and PCBs.	ARARs. If treated water needs to be discharged to surface water, these will be used in setting effluent discharge limits.
National Ambient Air Quality Standards (NAAQS)	Ambient Air Quality Standards	40 CFR 50	Defines air quality levels adequate to protect public health/welfare. Defines emissions limitations for sulfur oxides, particulate matter, carbon monoxide, ozone, nitrogen oxide, and lead.	ARARs for remedial alternatives resulting in air emissions if toxic pollutants are present.
Federal Resource Conservation and Recovery Act	Groundwater Protection Standards and Maximum Concentration Limits	40 CFR 264, Subpart F	Establishes standards for groundwater protection for several metals and pesticides.	ARARs for groundwater concentrations following remediation but there are no standards for LNAPL.
New Jersey				
Sludge Quality Criteria	Criteria for Sludge	NJAC 7:14-4 Appendix B-1	New Jersey Water Pollution Control Act Contaminant Indicators.	Potential ARAR for remedial alternatives resulting in the generation of sludges during groundwater or soil treatment.

Table 1A
Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
State of New Jersey Statutes and Rules	Technical requirements for remediation of free product.	7:26E-1	Require removal or treatment of recoverable LNAPL where practicable; treatment of residual LNAPL where practicable; containment of potentially mobile LNAPL where removal or treatment are not practicable.	ARAR for the remediation of the LNAPL.
New Jersey Department of Environmental Protection Residential Direct Contact Soil Cleanup Criteria	Residential Soil Cleanup Standards in New Jersey	N.J.A.C. 7-26D	Direct contact cleanup criteria for soils at residential sites.	TBC. Not promulgated. NJDEP requires delineation of contamination to residential levels.
NJDEP Non-Residential Direct Contact Soil Cleanup Criteria	Non-Residential Soil Cleanup Standards in New Jersey	N.J.A.C. 7-26D	Direct contact cleanup criteria for soils at industrial or commercial sites.	TBC. Not promulgated. Criteria may be considered in setting cleanup goals for contaminated soils at source areas or areas where industrial activities are planned.
NJDEP Impact to Groundwater Soil Cleanup Criteria	Soil Cleanup Standards that are Protective of Groundwater in New Jersey	N.J.A.C. 7-26D	Soil cleanup criteria for protection of groundwater.	TBC. Not Promulgated. Criteria may be considered in setting cleanup goals for contaminated soils at source areas.
State of New Jersey Statutes and Rules	Groundwater Quality Standards	N.J.A.C. 7:9-6 Groundwater Quality Standards	Establishes standards for the protection of ambient groundwater quality. Used as the primary basis for setting numerical criteria for groundwater cleanups.	ARAR for Class IIA aquifers.
State of New Jersey Statutes and Rules	Drinking Water Standards-Maximum Contaminant Levels (MCLs)	N.J.A.C. 7:10 Safe Drinking Water Act	Establishes MCLs that are generally equal to or more stringent the SDWA MCLs.	ARARs for groundwater concentrations following remediation but there are no MCLs for LNAPL.
State of New Jersey Statutes and Rules	National Secondary Drinking Water Standards-Secondary MCLs	N.J.A.C. 7:10-7 Safe Drinking Water Act	Establishes standards for public drinking water systems for those contaminants which impact the aesthetic qualities of drinking water.	ARARs for groundwater concentrations following remediation but there are no MCLs for LNAPL.
New Jersey Pollutant Discharge Elimination System (NJPDES)	Surface Water Discharge Criteria	N.J.A.C. 7:14a	Establishes discharge standards when written into permits.	ARARs. If treated water needs to be discharged to surface water, these will be used in setting effluent discharge limits.

Table 1A
Potential Chemical-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
Surface Water Criteria	New Jersey Criteria for Surface Water Quality	N.J.A.C. 7:9-4	Criteria for surface water classes	TBCs. If treated water needs to be discharged to surface water, these will be used in setting effluent discharge limits.
Prohibition of Air Pollution and Ambient Air Quality Standards	Air Quality Standards	N.J.A.C. 7:27-5 and N.J.A.C. 7:27-13	Prohibits air pollution and establishes ambient air quality standards	Potential ARAR for remedial alternatives which include technologies that result in air emissions.

Table 1B
Potential Action-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
Discharge of Groundwater or Wastewater				
Federal Clean Water Act	National Pollution Discharge Elimination System (NPDES)	40 CFR 122 and 125	Issues permits for discharge into navigable waters. Establishes criteria and standards for imposing treatment requirements on permits.	ARAR for the disposal of groundwater to surface water, although state ARAR takes precedence for discharge permit.
Federal Clean Water Act	General Pretreatment Regulations for Existing and New Sources of Pollution	40 CFR 403	Prohibits discharge of pollutants to a POTW which cause or may cause pass-through or interference with operations of the POTW.	ARAR. Discharge of pollutants including those that could cause fire or explosion or result in toxic vapors or fumes to POTW. Discharge to POTW unlikely at this site.
Federal Clean Water Act	Effluent Guidelines and Standards for the Point Source Category	40 CFR 414	Requires specific effluent characteristics for discharge under NPDES permits.	ARAR for the disposal of groundwater to surface water, although state ARAR takes precedence for discharge permit.
Federal Clean Water Act	Ambient Water Quality Criteria	40 CFR 131.36	Establishes criteria for surface water quality based on toxicity to aquatic organisms and human health.	ARAR if remedial alternative includes groundwater discharge to surface water. Federally-approved New Jersey groundwater and surface water standards take precedence over the Federal criteria.
Federal Clean Water Act	Water Quality Criteria Summary		Includes non-promulgated guidance values for surface water based on toxicity to aquatic organisms and human health. Issued by the EPA office of Science and Technology, Health and Ecological Criteria Division.	ARAR if remedial alternative includes groundwater discharge to surface water. Supplements above-referenced Ambient Water Criteria.
Federal Safe Drinking Water Act	Underground Injection Control Program	40 CFR 144	Establishes performance standards, well requirements, and permitting requirements for groundwater re-injection wells.	ARAR if remedial alternative includes re-injection of treated water. May also apply to the injection of surfactants or oxidants into the aquifer.
Water Pollution Control Act	Protection of water	33 U.S.C. 1251	Protects and maintains the chemical, physical, and biological integrity of the nation's water.	ARAR for remedial actions which may affect water quality.
Water Treatment and Disposal				
Effluent Limitations	Discharge requirements	33 U.S.C. 1251 Section 301	Technology-based discharge limitations for point sources of conventional, nonconventional, and toxic pollutants.	ARAR for remedial actions which include discharge of wastewater.
Water Quality Related Effluent Limitations	Discharge requirements	33 U.S.C. 1251 Section 302	Protection of intended uses of receiving waters (e.g., public water supply, recreations uses).	ARAR for remedial actions which include discharge of wastewater.
Toxic and Pretreatment Effluent Standards	Pretreatment standards for discharge into POTWs.	33 U.S.C. 1251 Section 307	Establishes list of toxic pollutants and promulgates pretreatment standards for discharge into POTWs.	ARAR for remedial actions which include discharge of wastewater.

Table 1B
Potential Action-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
National Pollutant Discharge Elimination System (NPDES)	Permitting for discharge into navigable waters.	33 U.S.C. 1251	Issues permits for discharge into navigable waters.	ARAR for remedial actions involving discharge to surface water.
State of New Jersey Statutes and Rules	The New Jersey Pollutant Discharge Elimination System	N.J.A.C. 7:14A	Establishes standards for discharge of pollutants to surface and groundwaters.	ARAR for the disposal of groundwater to surface water.
State of New Jersey Statutes and Rules	Groundwater Quality Standards	N.J.A.C. 7:9-6 Groundwater Quality Standards	Establishes standards for the protection of ambient groundwater quality. Used as the primary basis for setting numerical criteria for groundwater cleanups and discharges to groundwater.	ARAR if disposal of treated groundwater by reinjection is needed.
State of New Jersey Statutes and Rules	Surface Water Quality Standards	N.J.A.C. 7:9B Surface Water Quality Standards	Establishes standards for the protection and enhancement of surface water resources.	ARAR for the disposal of groundwater to surface water.
State of New Jersey Statutes and Rules	Wastewater discharge requirements	N.J.A.C. 7:9-5.1	Minimum treatment requirements and effluent standards for discharge to surface water.	ARAR for the disposal of groundwater to surface water.
Worker and Community Right to Know Act	Protects workers and community	P.L. 1983c.315 P.L. 1985c.543 Executive Order #161	Notification of presence of hazardous substances to State Emergency Planning Commissions and to local Emergency Planning Committees.	ARAR. Applies to all on-site treatment alternatives.
Disposal of Hazardous Waste				
Federal Resource Conservation and Recovery Act	General Waste Management Practices	40 CFR 260	Establishes procedures and criteria for modification or revocation of any provision in 40 CFR Part 260-265.	ARAR. Establishes general requirements for hazardous waste management.
Federal Resource Conservation and Recovery Act	Identification and Listing of Hazardous Waste	40 CFR 261	Identifies solid wastes which are subject to regulation as hazardous wastes.	ARAR. Generation of a hazardous waste possibly including spent carbon or contaminated soil. Hazardous waste must be handled and disposed of in accordance with RCRA. Chemical testing and characterization of waste required.
Federal Resource Conservation and Recovery Act	Standards Applicable to Generators of Hazardous Waste	40 CFR 262	Establishes requirements (e.g., EPA ID numbers and manifests) for generators of hazardous waste.	ARAR. Waste that is characterized as hazardous.
Federal Resource Conservation and Recovery Act	Standards Applicable to Transporters of Hazardous Waste	40 CFR 263	Establishes standards which apply to persons transporting manifested hazardous waste within the United States.	ARAR. Transport of waste that is characterized as hazardous.
Federal Resource Conservation and Recovery Act	Standards Applicable to Owners and Operators of Treatment, Storage and Disposal Facilities	40 CFR 264	Establishes the minimum national standards which define acceptable management of hazardous waste.	ARAR. Generation and storage of hazardous waste.

Table 1B
Potential Action-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
Federal Resource Conservation and Recovery Act	Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 265	Establishes minimum national standards that define the periods of interim status and until certification of final closure or if the facility is subject to post-closure requirements, until post-closure responsibilities are fulfilled.	Potential ARAR since remedies should be consistent with the more stringent 40 CFR 264 standards, as these represent the ultimate RCRA compliance standards and are consistent with CERCLA's goal of long-term protection of public health and welfare and the environment.
Federal Resource Conservation and Recovery Act	Land Disposal Restrictions	40 CFR 268	Identifies hazardous wastes which are restricted from land disposal. All listed and characteristic hazardous waste or soil or debris contaminated by a RCRA hazardous waste and removed from a CERCLA site may not be land disposed until treated as required by LDRs.	ARAR. Generated waste will need to meet LDRs for offsite disposal.
Federal Resource Conservation and Recovery Act	Hazardous Waste Permit Program	40 CFR 270	Establishes provisions covering basic EPA permitting requirements.	Potential ARAR. A permit is not required for on-site CERCLA response actions. Substantive requirements are added in 40 CFR 264.
Federal Resource Conservation and Recovery Act	RCRA	40 CFR 265	Establishes organic air emission standards for tanks, surface impoundments, and containers.	ARAR for hazardous waste treatment, storage, and disposal facilities (TSDFs) that receive new or re-issued permits or Class 3 modifications after 5 January 1995.
Federal Hazardous Material Transportation Act	Hazardous Materials Transportation Regulations	49 CFR 107, 171-177	Regulates transportation of hazardous materials.	ARAR since response action may involve transportation of hazardous materials.
State of New Jersey Statutes and Rules	Hazardous Waste	N.J.A.C. 7:26C Hazardous Waste	Establishes rules for the operation of hazardous waste facilities in the state of New Jersey.	Potential ARAR depending on hazardous waste disposal location.
General Remediation Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and Superfund Amendments and Reauthorization Act of 1986 (SARA)	National Contingency Plan	40 CFR 300, Subpart E	Outlines procedures for remedial actions and for planning and implementing off-site removal actions.	ARAR.

Table 1B
Potential Action-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
Federal Occupational Safety and Health Act	Worker Protection	29 CFR 1904	Requirements for worker protection and for recording and reporting occupation injuries and illnesses.	ARAR. Under 40 CFR 300.38, requirements of OSHA apply to all activities which fall under jurisdiction of the National Contingency Plan.
State of New Jersey Statutes and Rules	Technical Requirements for Site Remediation	N.J.A.C. 7:26E	Established minimum regulatory requirements for investigation and remediation of contaminated sites in New Jersey.	ARAR for all remedial action.
State of New Jersey Statutes and Rules	Emergency Response Notice of Release of Hazardous Substance to Atmosphere	NJSA 7:26, 26:2C-19	Control exposure to air pollution by immediate notification to the department hotline of any air release incident.	ARAR for any remedial alternative having the potential to result in an air release.
State of New Jersey Statutes and Rules	Notification of Spills	NJAC 7:21(E)	Immediate notification of any spill of hazardous substances.	ARAR for remedial alternatives having potential for a spill of a hazardous substance.
State of New Jersey Statutes and Rules	Restrictions of Noise	NJSA 13:1G-1 et.seq.	Prohibits and restricts noise which unnecessarily degrades the quality of life.	ARAR for all remedial action.
State of New Jersey Statutes and Rules	Investigation derived waste management	NJDEP's Guidance Document	Provides guidance on the disposition of IDW.	ARAR. To be considered during investigation.
State of New Jersey Statutes and Rules	Restrictions of Noise	NJAC 7:29-1	Sets maximum limits of sound from any industrial, commercial, public service or community service facility.	ARAR for all remedial actions.
State of New Jersey Statutes and Rules	General Requirements for Permitting Wells	NJAC 7:9-7	Regulates permit procedures, general requirements for drilling and installation of wells, licensing of well driller and pump installer, construction specification, and well casing.	ARAR when installing new wells or if existing wells should require modification.
State of New Jersey Statutes and Rules	Well Abandonment Procedures	NJAC 7:9-9	General requirements for sealing of all wells (e.g., single cased, multiple cased, hand dug, test wells, boreholes and monitoring wells, abandoned wells).	ARAR if any existing wells need to be abandoned and sealed.
State of New Jersey Statutes and Rules	Drilling Contractor Requirements	NJSA 58:4A-5 et.seq.	Well drillers licensing, supervision, inspection and sampling.	ARAR when additional wells are installed.
State of New Jersey Statutes and Rules	Groundwater Monitoring	N.J.A.C. 7:26-9	Groundwater monitoring system requirements.	ARAR for any remedial alternative requiring groundwater monitoring.
Off-Gas Management Federal Clean Air Act	National Primary and Secondary Ambient Air Quality Standards	40 CFR 50	Establishes emission limits for six pollutants (SO ₂ , PM ₁₀ , CO, O ₃ , NO ₂ , and Pb).	Emission of air pollutants may be of concern for some remedial technologies.
Federal Clean Air Act	Standards of Performance for New Stationary Sources	40 CFR 60	Provides emissions requirements for new stationary sources.	ARAR.

Table 1B
Potential Action-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
Federal Clean Air Act	National Emission Standards for Hazardous Air Pollutants	40 CFR 61	Provides emission standards for 8 contaminants including benzene and vinyl chloride. Identifies 25 additional contaminants, as having serious health effects but does not provide emission standards for these contaminants.	ARAR.
State of New Jersey Statutes and Rules	Standards for Hazardous Air Pollutants	N.J.A.C. 7:27 Air Pollution Control	Rule that governs the emitting of, and such activities that result in, the introduction of contaminants into the ambient atmosphere.	ARAR.
State of New Jersey Statutes and Rules	Permitting Conditions for air pollution control	N.J.A.C. 7:27-8	Establishes permit conditions for air pollution control apparatus.	ARAR if remedial action includes a technology that would result in air emissions.
State of New Jersey Statutes and Rules	Permitting Conditions for air pollution control	N.J.A.C. 7:27-11 and 17	Controls and prohibits air pollution, particle emissions, and toxic VOC emissions.	ARAR if remedial action includes a technology that would result in air emissions.
State of New Jersey Statutes and Rules	Incineration Requirements	N.J.A.C. 7:26-10	Specifies maximum air contaminant emissions rates, testing requirements, and minimum design standards.	ARAR if remedial alternative includes incineration.
State of New Jersey Statutes and Rules	Incineration Requirements	N.J.A.C. 7:26-11	Specifies maximum air containment emission rates, testing requirement, and minimum design standards during interim status.	ARAR if remedial alternative includes incineration.
State of New Jersey Statutes and Rules	Incinerator Permitting	N.J.A.C. 7:26-12	Delineates the information needs to be submitted in Part A and B of the permit application.	ARAR if remedial alternative includes incineration.

Table 1C
Potential Location-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
Executive Order Floodplain Management	Floodplain Management	Exec. Order No. 11988 40 CFR 2 6:302(b) and Appendix A	Requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.	ARAR if remedial activities take place in or near a 100-year or 500-year floodplain.
Federal Flood Plains Regulatory Requirements	Regulatory Requirements	(RCRA Location Standards (40 CFR 264.18)	This regulation outlines the requirements for constructing a RCRA facility on a 100-year flood plain.	ARAR if remedial alternatives include construction in or near a 100-year floodplain.
National Wildlife System	Protects national wildlife	16 U.S.C. 668 50 CFR 27	Restricts activities within a National Wildlife Refuge.	Not an ARAR since site is not a wildlife refuge.
Wild and Scenic Rivers Act	Prohibits adverse effects on scenic rivers.	16 U.S.C. 1274 40 CFR 6:302	Prohibits adverse effects on scenic rivers.	Not an ARAR since site is not on a river.
Clean Water Act	Prohibits discharge of dredged or fill material into wetlands	33 U.S.C. 1251 Section 404, 40 CFR 230, 231	Prohibits discharge of dredged or fill material into wetlands without a permit. Preserves and enhances wetlands.	ARAR for remedial alternatives which involve disturbance to wetlands.
Endangered Species Act	Protects endangered species	16 U.S.C. 1531	Restricts activities where endangered species may be present.	ARAR if endangered species are observed at the site during ecological site assessments.
Policy Floodplains/Wetlands Assessment	Floodplain assessment	EPA 1985 Statement	Provides federal policy for the assessment of floodplains and wetlands	ARAR for remedial alternatives that affect wetlands and floodplains.
National Historic Preservation Act	Protects historic places	16 U.S.C. 470	Requires federal agencies to take into account the effect of any federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or is eligible for inclusion in the National Register of Historic Places.	Not and ARAR since there are no areas that are included or eligible for inclusion in the National Register of Historic Places.
Historic Sites, Buildings and Antiquities Act	Protects national landmarks	16 U.S.C. ss 461-457	Requires federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	Not and ARAR since there are no areas that are included or eligible for inclusion in the National Register of Historic Places.
U.S. Army Corps of Engineers Nationwide Permit Program Rivers and Harbors Act of 1899	Army Corp. of Engineers Permit Program	33 CFR 330	Prohibits activity that adversely affects a wetland if a practical alternative that has less effect is available.	ARAR for remedial alternatives which have the potential to affect wetlands.
	Army Corp. of Engineers Permit Program	33 CFR 320-330	Establishes a permit program for dams, dikes, dredging, and other construction in navigable waters of the U.S.	Not and ARAR since site is not located with area covered by regulation.
Executive Order Protecting Wetlands	Protection of Wetlands	Executive Order No. 11990	Requires Federal agencies to minimize the destruction, loss, or degradation of all wetlands affected by Federal activities.	ARAR for remedial alternatives which have the potential to affect wetlands.
Fish and Wildlife Coordination Act	Requires approval for modification of water body	16 U.S.C. 661 40 CFR 2 6:302(g)	Requires consultation with the U.S. Fish and Wildlife Services when a Federal department or agency proposes or authorizes any modification of any stream or other water body, and adequate provision for protection of fish and wildlife resources.	ARAR if action is covered by regulation.

Table 1C
Potential Location-Specific Applicable or Relevant and Appropriate Requirements
Diamond Head Oil Superfund Site
Kearny, New Jersey

Act/Authority	Criteria/Issues	Citation	Brief Description	Applicability
National Ambient Air Quality Standards (NAAQS)	Air Quality Standards	40 CFR 50	Establishes non-attainment zones with respect to health-based criteria.	ARAR for remedial activities which emit restricted contaminants into the atmosphere.
Federal Endangered and Non-Game Species Act	Protection of threatened and endangered species	N.J.S.A. 23:2A-1	Standards for the protection of threatened and endangered species.	ARAR if any species exist at the site.
Flood Hazard Area Regulations	Protection of floodplains	N.J.A.C. 7:13	Protects floodplains through permitting requirements for construction and development activities	ARAR if remedial activities are located in or near a 100- or 500-year floodplain.
Flood Hazard Area Control Act	Delineates flood hazard areas	N.J.S.A. 58: 16A-50	Delineates flood hazard areas and regulates use.	ARAR if remedial activities are in or near a 100- or 500-year floodplain.
Wetland Act of 1970	Establishes wetland regulated activities	N.J.S.A. 13:9A-1 et.seq.	Establishes listing and permitting requirements for regulated activities	ARAR. Establishes listing and permitting requirements for regulated activities
Freshwater Wetlands Protection Act	Establishes freshwater wetlands regulated activities	N.J.S.A. 13:9B	Establishes listings and permitting requirements for regulated activities in state freshwater wetlands	Potential ARAR. Establishes listings and permitting requirements for regulated activities in state freshwater wetlands
Open Lands Management	Considers recreational projects during remediation	N.J.A.C. 7:2-12.1 et.seq.	Considers impact of remedial actions on recreational projects funded by Open Lands Management Grants.	Not an ARAR for remedial actions on recreational projects funded by Open Lands Management Grants.
Natural Areas System	Protects natural area sites	N.J.A.C. 7:2-11	Protects natural area sites listed under the Natural Areas Register.	Not an ARAR since site is not listed on the Natural Areas Register.
State Trails System	Protects state trails	N.J.S.A. 13:8-30 et. seq.	Requires that use of trail does not interfere with nature; maintains natural and scenic qualities.	Not an ARAR since site does not have trails.
New Jersey Wild and Scenic Rivers System	Protects Scenic River systems	N.J.S.A. 13:8-45 et. seq.	Governs component river area, flood hazard area, or part of state park, wildlife refuge or similar area.	Not an ARAR since site is not component river area, flood hazard area, or part of state park, wildlife refuge or similar area.
New Jersey Threatened Plant Species	Lists threatened plant species.	New Jersey's Threatened Plant Species	Lists threatened plant species.	ARAR if remedial actions impact threatened plant species.
Endangered Plant/Animal Species Habitats	Lists threatened habitats where endangered species occur.	New Jersey's Endangered Species Act	Lists threatened habitats where endangered species occur.	ARAR if remedial actions impact endangered species.

5.0 Response Action Objectives (RAOs)

General RAOs are defined by the NCP and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (as amended by the Superfund Amendments and Reauthorization Act (SARA)) and apply to all Superfund sites. CERCLA defines the statutory requirements for developing remedies.

Site-specific RAOs relate to specific contaminated media and potential exposure routes identified to be of concern at a site. The RAOs identify target remedial goals for protecting human health and the environment that are established on the basis of the nature, extent, fate, and transport of the contamination, the resources that are currently and potentially threatened, and the potential for human and environmental exposure.

Both the level of contamination and the potential exposure route are important considerations in developing RAOs at a site. For example, protection at a site can be achieved by both lowering the contaminant levels and by reducing the potential for exposure through a particular exposure route.

The RAOs for this IRM are based on the requirements in NJAC 7:26E-1.13(b)2(v) and NJAC 7:26E-6.1(d) as follows:

- Removal or treatment of recoverable LNAPL where practicable
- Treatment of residual LNAPL where practicable
- Containment of potentially mobile LNAPL where removal or treatment are not practicable

The RAOs are intended to address the LNAPL source, to the maximum degree practicable, thus reducing the unacceptable risks to potential human and ecological receptors by controlling future contributions from the LNAPL source to the media to which exposure can occur at the Site. Following the IRM, future investigations and remedial actions can focus on addressing sorbed and dissolved-phase chemical contamination without continuing contributions from the LNAPL to the various exposure pathways available at the Site (human and environmental).

6.0 Preliminary Remedial Goals (PRGs)

Remediation goals are site-specific, quantitative goals that define the extent of cleanup required to achieve the RAOs. To meet the RAOs for LNAPL within the source area at the Site, Preliminary Remediation Goals (PRGs) were developed to aid in defining the extent of contaminated media requiring remedial action. There are no numeric chemical specific ARARs for LNAPL. The ARARs are set based on what can be practically achieved by the remedial technologies given the LNAPL nature and extent and site characteristics which govern its setting. Therefore, the PRGs for the mobile and residual LNAPL are as follows:

- Reduce volume of mobile LNAPL to the maximum practicable level
- Reduce mass of residual LNAPL to the maximum practicable level

The maximum practicable level of LNAPL reduction will be empirically determined by the process of remedial technology selection and application. The practical limit of the remediation will be determined by carefully selecting, testing (i.e., lab- and field-scale), operating, and monitoring an appropriate technology. Through a systematic process of

technology selection and design, the most cost-effective technology will be applied to meet the PRGs. During the screening and evaluation stages, lab and field analyses will be performed on the LNAPL to estimate the maximum practicable levels of LNAPL reduction for the various technologies being considered. Only those technologies capable of removing the largest amount of LNAPL will be considered. The actual maximum practicable level of LNAPL reduction will then be determined during implementation by using an observational approach which uses actual system operation data (e.g., mass recovery rates) and In Situ monitoring data (e.g., in-well LNAPL thickness) to assess and predict the theoretical maximum recovery. LNAPL reduction data will be compared to the estimates and adjustments made to the system as necessary to ensure that the remediation system is operating as intended. System operation will continue until a point of diminishing returns occurs and site conditions are or can be made protective through implementation of more cost-effective means. The point of diminishing returns will be assessed by analysis of the cumulative system and well monitoring data and identification of a point in time where additional operation will not appreciably improve site conditions (e.g., system has reached 90-percent of its theoretical maximum).

7.0 Identification and Screening of Technologies for LNAPL Treatment

7.1 General Response Actions (GRAs)

The GRAs for mobile and residual LNAPL are presented in Table 2. The GRAs are categories of treatment which are further divided into individual technologies for screening in Table 3.

TABLE 2	
General Response Actions for LNAPL Source Area	
Diamond Head Oil Superfund Site, Kearny, New Jersey	
General Response Action	Evaluation
No Action	Required by the National Contingency Plan for comparison to other actions.
Monitoring	Used in conjunction with other containment and treatment GRAs to monitor effectiveness.
Institutional Controls	Reduces the likelihood of exposure to the LNAPL (direct contact with or ingestion or inhalation).
Monitored Natural Attenuation	Reduces LNAPL mobility, toxicity, and volume through natural physical, chemical, and biological processes. The main processes include dissolution, biodegradation, and volatilization.
Containment	Minimizes exposure to LNAPL by confining and reducing its mobility.
In Situ Treatment	Reduces mobility, toxicity, and volume of LNAPL through in-place treatment using chemical, physical, or biological treatment processes.
Fluid Collection, Treatment, Discharge, and Disposal	Collection involves removal of LNAPL from the ground via fluid pumping. Therefore, reduces volume of LNAPL. If water is collected with the LNAPL, then it would be treated and the treated effluent may be discharged to surface water, groundwater, or a sewer system. In addition to treatment for LNAPL, treatment would need to address other dissolved contamination in the water. The recovered LNAPL will need to be disposed of offsite. Offsite disposal minimizes the likelihood of exposure to LNAPL-contaminated media through placement in a controlled environment after removal from the Site.
Soil Excavation, Treatment, and Disposal	Reduces volume of LNAPL-contaminated media via excavation and removal from the Site. Some dewatering would likely be required during excavation and the water would need to be treated and disposed as discussed above for Fluid Collection. Treatment of the excavated material would be done onsite, if needed, to meet requirements for transport and Disposal (LDRs). Offsite disposal minimizes the likelihood of exposure to LNAPL-contaminated media through removal from the Site and placement in a controlled environment.

7.2 Applicable Remedial Technologies

The technology types and process options considered under each of the GRAs for the mobile and residual LNAPL are presented and screened in Table 3. Technologies that were determined to potentially interfere with future remedial investigations or full-scale remedial measures for soil or groundwater were screened out. Technologies were screened based on the following:

- **Effectiveness** — A key aspect of the screening evaluation is the effectiveness of each technology in treating or containing mobile and residual LNAPL.
- **Implementability** — Implementability is evaluated in terms of both the technical and administrative feasibility of constructing, operating, and maintaining the technology. Technical feasibility refers to the ability to construct, reliably operate, and comply with regulatory requirements during implementation of an IRM. Technical feasibility also refers to the future operation, maintenance, and monitoring after the remedial action has

been completed and the ability to implement the interim remedial action consistent with proposed future land use standards. Administrative feasibility refers to the ability to obtain approvals and permits from regulatory agencies; the availability and capacity of treatment, storage, and disposal services; and the requirements for and availability of specialized equipment and technicians.

- **Cost** — The primary purpose of the cost screening criterion is to allow comparative estimates between remedial technologies.

In Table 3, the technologies that are not considered feasible after screening are shown in italicized text on the table. Technologies retained after screening are bolded. Screening comments are also provided for each technology. Based on the evaluation provided in Table 3, the following technologies were retained under each GRA for further consideration in assembling remedial alternatives:

- **No Action** – Retained to meet the requirements of the National Contingency Plan. No remedial technologies are implemented with this option.
- **Monitoring** – Retained to monitor the effectiveness of the chosen remedial action over the course of time. This may include monitoring of LNAPL and groundwater concentrations and water and LNAPL levels in wells over the course of IRM implementation.
- **Institutional Controls** - Institutional controls for soil consist of restricting access to contaminated soil through land use restrictions (such as deed notices under NJDEP requirements) or Classification Exception Areas (CEA) restricting groundwater use.
- **In Situ Treatment** – The technologies retained include the following:
 - *Air Sparge Treatment*- This technology involves injecting air into groundwater wells to increase volatilization of mobile and residual LNAPL. This technology may require vapor collection and treatment.
 - *Soil Vapor Extraction* – Soil vapor extraction (SVE) is retained for use in conjunction with air sparging for collection of fugitive vapors. SVE alone would not be effective due to the extremely shallow water table.
 - *Washing / Flushing* – Surfactants or co-solvents are used to enhance desorption and dissolution of the LNAPL thereby enhancing recovery. It's generally more applicable for sites with large volumes of mobile LNAPL.
 - *Enhanced Bioremediation* – This technology involves injection of substrates or nutrients to enhance biodegradation of residual LNAPL. Other adaptations to this technology include the use of surfactants and/or solvents to enhance dissolution and bioavailability of the LNAPL compounds.
 - *Biosparge Treatment* - This technology involves passing air at lower flow rates over the impacted media to provide oxygen for enhancing bioremediation. Because of the lower flow rates compared to air sparge treatment, vapor collection is not needed.
 - *Phytoremediation* – This technology uses plants and microbes associated with the plant root system to stabilize, degrade, and/or extract contaminants from the soil and groundwater by either adsorption or absorption and may be used for treatment of residual LNAPL.

- **Fluid Collection, Treatment, Discharge (Treated Water), and Disposal (LNAPL) –** The technologies retained include the following:

- *Fluid Collection*

- *Multi Phase Extraction* – This technology involves the use of a high-vacuum pump to enhance recovery of fluids including LNAPL, water, and soil gas. It can accomplish simultaneous LNAPL recovery and vadose zone aeration to stimulate biodegradation. It would require a water treatment system, treated water discharge, and offsite disposal for the LNAPL.
- *Recovery Trench* - Passive or active fluid recovery trench technology allows for the separation of LNAPL from groundwater for extraction and offsite disposal, preventing mobile LNAPL from migrating offsite.
- *Recovery Wells* – LNAPL recovery wells allow for the extraction of mobile LNAPL, similar to LNAPL recovery trenches, however recovery wells may be installed in locations at which trenching would be difficult, such as areas with limited accessibility for construction equipment.

- *Fluids Treatment* – Treatment would be needed for any water extracted during LNAPL recovery. Treatment technologies for the extracted water would depend on the dissolved contamination in the water not only by LNAPL but also by other contaminants found at the Site. Technologies that may be used include oil:water separation, air stripping, adsorption, and oxidation.

- *Discharge / Disposal* – The treated groundwater may be discharged to surface water, re-injected, or transported to an offsite disposal facility. The recovered LNAPL would also require transport and disposal at an offsite appropriately permitted facility.

- **Soil Excavation, Treatment, and Disposal** – The technologies retained include the following:

- *Excavation* – This is the physical removal of shallow residual LNAPL-contaminated soils. This technology is generally considered to depths of less than approximately 20 feet, which is the general limitation of standard excavation equipment. Excavation of soils below the shallow water table would require dewatering and water treatment, discharge, and offsite disposal if LNAPL is recovered from the excavation.

- *Treatment*

- *Ex Situ Stabilization* – This technology involves the addition of a solidification agent such as cement to prepare the material for transportation and to meet LDRs, if needed.
- *Ex Situ Low-Temperature Thermal Desorption* – A thermal processing unit is used to heat soil to a temperature at which contaminants of concern are volatilized to LDRs and removed via offgas collection and treatment prior to atmospheric discharge. Soil can then either be replace onsite or shipped offsite for disposal, depending upon the concentrations of other contaminants in soil.

- *Disposal* – This technology involves the disposal of removed material at an offsite appropriately permitted landfill.

8.0 Conclusions

A preliminary screening of remedial technologies was performed to identify those technologies, which based on qualitative assessment of implementability, effectiveness, and cost, should be considered further and included in remedial alternatives for the IRM for the mobile and residual LNAPL at the Site.

The Phase 2 focused investigation will obtain data on the extent and characteristics of the LNAPL present at the Site. Pilot tests are also recommended to assess the effectiveness of LNAPL fluid recovery methods and air/bio sparging to determine if these technologies may be effective at removing and reducing mobile and residual LNAPL, thereby achieving the RAOs established for the source area of the Site. The results of the Phase 2 investigation and pilot testing will be incorporated into the focused feasibility study, which will serve as the basis for the selection of an IRM for LNAPL at the Site.

9.0 References

CH2M HILL. Final Phase 1 Remedial Investigation Technical Memorandum, Diamond Head Oil Superfund Site, Kearny, New Jersey. February, 2005.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
No Action	No Further Action	None	No action.				Required by NCP for comparison with other alternatives; does not meet RAOs.
Monitoring	Monitoring	Measuring LNAPL thicknesses Groundwater sampling	Monitor the effectiveness of the chosen IRM over the course of time.	Technically implementable	Not Applicable	Low	Does not meet RAOs when implemented alone; is applicable only in conjunction with other technologies.
Institutional Controls	Institutional Controls	Land Use Restrictions	Restrict access to LNAPL-contaminated soils through local ordinances, building permits, restrictive covenants on property deeds (Deed Notice) and state registries of contaminated sites.	Not Applicable	Moderate	Low	Does not meet RAOs when implemented alone; may be applicable in conjunction with other technologies.
	Groundwater Use Restrictions	Access restrictions to groundwater	Establish a Classification Exception Area (CEA) for the area impacted by LNAPL, which will impose restrictions on groundwater use.	Not Applicable	Moderate	Low to moderate	Does not meet RAOs when implemented alone. Potentially applicable in conjunction with other technologies.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
Monitored Natural Attenuation (MNA)	Monitored Natural Attenuation	Monitored natural attenuation of groundwater.	Use of naturally occurring physical, chemical and biological processes such as dissolution, biodegradation and volatilization to reduce LNAPL concentrations.	Technically implementable	Low	Moderate	Based on NJAC 7:26E-6.1(d), "...natural remediation of free and/or residual product will not be allowed." Technically infeasible for LNAPL. Does not meet RAOs.
Containment	Passive Hydraulic Controls	Slurry or Sheet-pile Wall	Physical barrier to groundwater migration.	Technically implementable	High	Low to Moderate	Potentially feasible to provide containment but does not reduce or remove LNAPL. Does not meet RAOs.
	Vertical Subsurface Barriers	Grout Curtain	Create subsurface barrier to horizontal GW flow by grout injection.	Technically implementable	Moderate	Moderate	Potentially feasible to provide containment but does not reduce or remove LNAPL. Does not meet RAOs.
	Surface Controls	Grading	Reshape topography to control infiltration, runoff, and erosion.	Technically implementable	Low	Low	Potentially feasible only if used in conjunction with capping and other technologies. Would need to be coordinated with future land use plans. Can be used in conjunction with other options to meet future use needs. Does not reduce or remove LNAPL and does not meet RAOs.
		Revegetation	Add topsoil, seed and fertilize to establish vegetation (to control erosion and reduce infiltration).	Technically implementable	Low	Low	Potentially feasible only if used in conjunction with capping and other technologies. Would need to be coordinated with future land use plans. Can be used in conjunction with other options to meet future use needs. Does not reduce or remove LNAPL and does not meet RAOs.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
	Horizontal Subsurface Barriers	Block Displacement	Encapsulate block of soil with grout in conjunction with vertical barriers.	Technically implementable	High	Moderate to High	This technology may prohibit access to contaminated media for future remedial investigation/remedial actions. Does not reduce or remove LNAPL and does not meet RAOs.
	Cover	Soil	Place clay over contaminated soils.	Technically implementable	Low	Moderate	This technology does not address LNAPL at and below the water table and may prohibit access to contaminated media for future remedial investigation/remedial actions. Does not reduce or remove LNAPL and does not meet RAOs.
		Multi-layer	Cap includes a 2 foot thick clay layer and an impermeable geomembrane liner. In addition, a drainage layer and freeze-thaw protective layer are included in cap.	Technically implementable	Low	High	This technology does not address LNAPL at and below the water table and may prohibit access to contaminated media for future remedial investigation/remedial actions. Does not reduce or remove LNAPL and does not meet RAOs.
		Asphalt	Place asphalt or concrete over contaminated soils.	Technically implementable	Low	Moderate	This technology does not address the LNAPL at and below the water table and may prohibit access to contaminated media for future remedial investigation/remedial actions. Does not reduce or remove LNAPL and does not meet RAOs.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
In Situ Treatment	Physical/Chemical	<i>In Situ Chemical Oxidation (ISCO)</i>	<i>Degrade contaminants by chemical oxidation. Typical oxidants include ozone, hydrogen peroxide, permanganate, and persulfate.</i>	<i>Technically implementable but highly dependent on the contaminant quantity requiring oxidation</i>	<i>Demonstrated in high permeability soils. Less effective in low permeability soil; Moderate</i>	<i>High</i>	<i>This technology may be capable of reducing the quantity of LNAPL at the Site; however the quantity of reagent required to oxidize LNAPL in-situ would likely be difficult to inject and cost-prohibitive. If hydrogen peroxide is used, then heat generated from the reaction would likely mobilize residual LNAPL during and after implementation, and may result in significant generation of vapors. This technology is unproven for large LNAPL sites.</i>
		Stabilization/Solidification	Immobilize contaminants using solidification agents.	Technically implementable	Moderate	Moderate	This technology may prohibit access to contaminated media for future remedial investigation/remedial actions.
		<i>Shallow Soil Mixing</i>	<i>Mixing of soil in-place using large augers to mix in treatment amendments and reduce LNAPL concentrations.</i>	<i>Technically implementable</i>	<i>Moderate to High</i>	<i>High</i>	<i>Potentially feasible for mobile and residual LNAPL, but only as an enhancement with other technologies. Does not meet RAOs by itself.</i>
		Air Sparging	Inject air into groundwater to volatilize and enhance aerobic biodegradation of amenable contaminants. This is often combined with the use of SVE to capture the air.	Technically implementable	Moderate	Moderate	This technology is expected to reduce the volume of LNAPL at the Site. Feasible for mobile and residual LNAPL as well as treatment of other contaminants (e.g., the VOCs). Also stimulates aerobic biodegradation of organic contaminants.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
		Soil Vapor Extraction (SVE)	Extract contaminants by establishing a vacuum.	Technically implementable, but difficult due to shallow water table at the Site.	Moderate to High	Moderate	This technology may reduce the volume of LNAPL at the Site. While feasible, implementation would be challenging due to shallow water table. However, could be combined with air sparging to recover injected air in the shallow unsaturated soils.
		Washing/ Flushing	Wash or flush soil with water or surfactant.	Technically implementable	Moderate	High	This technology is expected to reduce the volume of LNAPL at the Site. It is cost-effective for sites with large quantities of mobile LNAPL. A large water extraction, treatment, and disposal system would be required for this technology and would make it costly in comparison to others if the quantity of mobile LNAPL is small.
		Vitrification	Melt/solidify soil matrix using electric currents.	Technically implementable	Moderate	High	Limited commercial applications. Would prevent access for future investigation/remediation efforts. Very costly technology relative to other technologies.
		Pneumatic Fracturing	Fracturing of the consolidated formation to increase permeability and thus increasing effectiveness of In Situ treatment.	Not applicable for sites with unconsolidated soil	Low	High	IRM is focused on shallow LNAPL contamination, and fracturing is not necessary based on moderate subsurface hydraulic conductivities.
	Biological	Enhanced Bioremediation	Degrade contaminants by stimulating biological growth through addition of an organic substrate and/or nutrients.	Technically implementable for residual LNAPL only	Low- Mobile LNAPL Moderate-Residual LNAPL	Moderate	This technology is expected to reduce the volume of LNAPL at the Site. Feasible for residual LNAPL only. This technology is not feasible for mobile LNAPL.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
		Phytoremediation	Phytoremediation uses plants and microbes associated with the plant root system to stabilize, degrade, or extract contaminants from the soil and groundwater by either adsorption or absorption.	Technically implementable	Low to Moderate	Low	Generally, this treatment works on low levels of contamination and works best when combined with other treatment remedies. It can be effective at stabilizing and treating shallow contaminants that may be outside the zone of active treatment.
		Biosparging	Biologically degrade organics through stimulation of aerobic organisms by the addition of oxygen in air. The addition of air is at low flow so there is no need for using SVE to capture vapors.	Technically implementable	Low to Moderate	Low to Moderate	This technology is expected to reduce the volume of LNAPL at the Site. Feasible for residual LNAPL only and for the aerobically biodegradable compounds only.
	Thermal	Hot Air or Steam Stripping	Inject hot air or steam/ to vaporize volatile and semi-volatile contaminants and recover the vapors.	Technically implementable	Moderate to High	High	Much more costly than other In Situ technologies such as air sparging / biosparging. Mobilizing LNAPL and vapor collection would be difficult due to shallow groundwater table.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
		<i>Radio Frequency Stripping</i>	<i>Use network of Radio Frequency Transmitters to heat soil; vaporize volatile and semi-volatile compounds, and collect them with a vapor extraction system.</i>	<i>Technically implementable</i>	<i>Moderate to High</i>	<i>High</i>	<i>Much more costly than other In Situ technologies. Vapor extraction would be difficult to implement due to shallow groundwater table.</i>
Fluid Collection, Treatment, Discharge, Disposal	Collection - LNAPL extraction	Recovery Trench	Trenches within areas of mobile LNAPL are installed and backfilled with low-permeability material such as pea gravel. LNAPL preferentially flows into the low-permeability material and collects in sumps for extraction.	Technically implementable	Low to Moderate	Moderate	This technology is retained for the recovery of mobile LNAPL only.
		Recovery Wells	Large-diameter boreholes are installed with extraction wells and sumps. The boreholes are backfilled with low-permeability material such as pea gravel.	Technically implementable	Low to Moderate	Moderate	This technology is retained for the recovery of mobile LNAPL only. Recovery wells could be installed in areas with subsurface obstructions using air-rotary or other drilling methods.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
	Collection - Multi Phase Extraction	Multi Phase Extraction	Simultaneous extraction of LNAPL, groundwater, and soil gas	Technically implementable	Moderate	Moderate to High	This technology is expected to reduce the volume of LNAPL at the Site. Feasible due to shallow water table.
Fluid Collection, Treatment, Discharge, Disposal	Treatment - Physical-Chemical	Oil:Water Separation	Phase separation process to remove oil from water stream	Technically implementable	Moderate	Low	Feasible as a form of pre-treatment for alternatives that extract LNAPL and groundwater and require treatment prior to discharge.
		Air Stripping	Phase separation from dissolved-phase to vapor-phase by forced air	Technically implementable	Moderate to High	Moderate	Not appropriate for LNAPL, but feasible as a form of treatment for alternatives that extract groundwater and require treatment prior to discharge.
		<i>Steam Stripping</i>	<i>Phase separation by steam and forced air</i>	<i>Technically implementable</i>	<i>High</i>	<i>High</i>	<i>Feasible, but only necessary for extremely high volatile contaminant concentrations and semi-volatiles. Highly unlikely to be applicable for this Site.</i>
		Adsorption	Contaminants are removed from the waste stream by adsorption with Granular Activated Carbon or other adsorptive media such as activated clay	Technically implementable	Moderate to High	Moderate	Not appropriate for LNAPL, but feasible as a form of treatment for groundwater requiring treatment prior to discharge.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
		Oxidation	Chemical, photo, or other oxidation process whereby organic contaminants are converted to carbon dioxide and water	Technically implementable	Moderate to High	High	Feasible for destructive treatment for a broad range of organic contaminants.
Fluid Collection, Treatment, Discharge, Disposal	Discharge	Groundwater: Surface water Re-injection Publicly Owned Treatment Works (POTW)	Includes various options for the discharge of treated groundwater.	Technically implementable	Moderate	Low to High	Potentially feasible discharge to surface water. Re-injection will likely not be feasible due to the high water table and there is no close by POTW sewer so water may need to be hauled for a POTW discharge.
Fluid Collection, Treatment, Discharge, Disposal	Disposal	LNAPL: Offsite Treatment Storage and Disposal Facility (TSDF)	Disposal of extracted LNAPL at an offsite TSDF.	Technically implementable	Moderate	Low to High	Feasible transport and disposal at an offsite TSDF.
Excavation, Treatment, Disposal	Excavation of Shallow Soils	Backhoe/Front-end Loader	Physically remove shallow soils.	Technically implementable	Moderate	High	This technology is expected to remove LNAPL within the area of the excavation. Can be executed to depths of about 20 feet, shallow depth to water would require construction dewatering during excavation.

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Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
Excavation, Treatment, Disposal	Treatment - Physical/ Chemical	Stabilization	Immobilize free product and contaminants to prepare material for transport and disposal.	Technically implementable	Moderate	High	Feasible, construction dewatering may be required. Applicable if needed to prepare soils for transport and to meet LDRs.
	Treatment - Thermal	Low-Temperature Thermal Desorption	Processing soil through thermal treatment unit desorbs contaminants from soil and removes them in the off-gas, which also may require treatment.	Technically implementable	Moderate to High	High	Feasible for treatment of excavated soils containing residual LNAPL if required to meet LDR. Not feasible if LNAPL is present as free flowing liquid in the soil.
		Onsite Incineration	Combust soils at high temperature.	Technically implementable	Moderate	High	Not cost competitive. Extensive treatability testing required; air treatment and permitting requirements are substantial.
		Plasma	Expose soils to super-heated plasma.	Technically implementable	High	High	Extensive treatability testing required; costs similar to incineration; unproven technology.
		Infrared	Decompose contaminants with infrared radiation.	Unproven technology	Moderate to High	High	Extensive treatability testing required; costs similar to incineration; unproven technology.
		Wet Air Oxidation	Use high temperature and pressure to thermally oxidize contaminants.	Technically implementable	Moderate to High	High	Not cost competitive.
		Offsite Incineration	Combust soils in offsite commercial incinerator.	Technically implementable	Moderate to High	High	Not cost competitive.

TABLE 3

Technology/Process Option Evaluation— Source Area Mobile and Residual LNAPL Interim Remedial Measure

Diamond Head Oil Superfund Site, Kearny, New Jersey

General Response Action	Remedial Technologies	Process Options	Description	Technical Implementability	Effectiveness	Capital and O&M Cost	Screening Comments
Excavation, Treatment, Disposal	<i>Disposal - Asphalt batching</i>		<i>Incorporation of recovered LNAPL into asphalt material for reuse in paving applications.</i>	<i>Technically implementable. The physical and chemical characteristics of the recovered LNAPL may not be appropriate for asphalt batching.</i>	<i>Moderate</i>	<i>Low</i>	<i>Liability of waste re-use from a Superfund site would be a concern.</i>
	Disposal - Offsite	RCRA Subtitle C or Subtitle D Landfill	Remove material from site for disposal in RCRA Subtitle C or D permitted landfill.	Technically implementable	High	High	Soils are likely below any hazardous waste characterization limits and can be disposed in a Subtitle D Landfill. However soils will be tested and any soils failing TCLP limits may also be subject to land disposal restrictions prior to disposal in Subtitle C landfill.

Note: Remedial technologies are screened for Implementability, Effectiveness, and Cost based on criteria rankings of "Low", "Moderate", and "High".

Remedial technologies in blue italics have been screened from further consideration because they prohibit access to contaminated media for future remedial investigation/remedial actions.

Remedial technologies in red italics have been screened from further consideration based on the screening criteria and whether the technology would meet the RAOs.

Remedial technologies in bold have been retained for inclusion in remedial alternatives.

CEA – Classification Exception Area

SVE – soil vapor extraction

ISCO – in-situ chemical oxidation

IRM – Interim Remedial Measure

LNAPL – light non-aqueous phase liquid

NA – not applicable

NCP – National Contingency Plan

POTW – Publicly Owned Treatment Works

TSDF – Treatment Storage and Disposal Facility